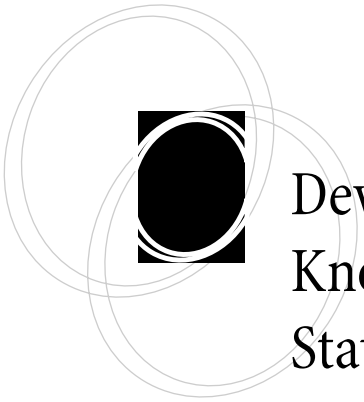

Developing an Institutional Knowledge Bank at Ohio State University: From Concept to Action Plan

Sally A. Rogers

abstract: There is a growing interest among academic institutions in collecting, preserving, and creating value-added services from digital content produced in teaching and research. Ohio State University plans to build on existing initiatives to create an institutional repository called the Knowledge Bank. An implementation plan and cost assessment are in preparation.

The emphasis on distance learning and instructional technology at many universities in recent years has led to an increased awareness that the digital content being created by members of the academic community is an institutional asset. Difficult economic times have heightened the need for universities to identify new ways to generate revenue. As a result, there is a growing interest among university administrators in collecting, in preserving, and in creating value-added services from the digital content produced in conjunction with teaching and research. This interest aligns well with the mission of academic libraries, although it requires the library to expand its focus to include management of unpublished as well as published electronic content.

At the same time, many academic librarians are working to create change among their campus communities by talking about the rising costs of journal subscriptions and encouraging scholarly publication in new alternative lower-cost journals. Some have taken responsibility for hosting such alternative publishing venues, becoming electronic publishers themselves. Certainly academic libraries are well qualified to provide leadership and coordination in these arenas but they, too, have limited resources. How can such challenges be met?

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One possible solution is for the library to recognize and to articulate the convergence that is occurring among the various digital initiatives in which the university has been engaged so that potential synergies and opportunities for more significant outcomes through collaboration are recognized. Funding, whether the source is internal or external, will be easier to obtain if it can be shown that it will have a broad and lasting impact and move the university toward achievement of its vision. This article describes one research university's perspective on these issues and its interest in building an Ohio State University "Knowledge Bank." It also examines current trends and future directions in the management of academic digital content.

The Knowledge Bank Concept

At Ohio State University (OSU), the concept of a "Research Bank" or "Knowledge Bank" was first described by the University's Distance Learning/Continuing Education Committee in 2001. The Committee, charged with developing a plan to advance distance education, defined the Knowledge Bank as an "interdisciplinary, multi-media storehouse of knowledge capital." Its purpose was to collect, to index, and to preserve digital content produced by faculty and to support the creation of new research content and learning packages to be deposited into the Knowledge Bank.[1] Revenue generation was a desired outcome of this process as well. In the fall of 2001, a planning committee chaired by Joseph J. Branin, director of University Libraries, was formed to investigate the validity of the concept and what it would take to implement an OSU Knowledge Bank. Membership included representatives from the Libraries and the University's offices of the Chief Information Officer and Academic Affairs. In addition, two corporate representatives from the Online Computer Library Center, Inc. (OCLC) and Chemical Abstracts Service (CAS) were asked to lend their expertise to the group.

The OSU Knowledge Bank Planning Committee initially defined the Knowledge Bank as an institutional repository similar to the DSpace project being created by the MIT Libraries in partnership with the Hewlett-Packard Corporation.[2] The committee envisioned it as both a *"referatory,"* providing links to digital objects and a *repository,* capable of archiving the increasing volume of digital content created at OSU for long-term use, dissemination, and preservation. Subsequently, however, the committee's chair proposed a broader view in which the Knowledge Bank included the full array of digital assets and information services available to or being created by OSU faculty, staff, and students. Using this broader definition, many components of the Knowledge Bank already exist—for example, the Libraries' catalog, the sizeable number of electronic journals and reference databases available through OhioLINK (a consortium of Ohio libraries), and electronic theses and dissertations. The institutional repository then became another component, yet to be built, within the larger Knowledge Bank. The advantage of this approach is that it promotes integration of all forms of academic digital content and the recognition that seemingly independent initiatives are actually related.

While the first generation of digital library projects were focusing on digitizing materials in particular collections or disciplines, instructional technologists were developing course Web sites, electronic course packs, and learning objects. We are now seeing that these initiatives overlap and that more integration is desirable to make it

easier for students to find and use relevant, high quality library resources in support of a particular course or program. We also want to help them minimize the cost of their education by making clear what resources are available from the library at no additional charge. Integration to search across repositories of learning objects and digital library content also is desirable, and standards are being developed to promote such interoperability.

Daniel Greenstein notes, "Scholarship—at last—is beginning to influence the way in which digital libraries are thinking about their technical infrastructure. While they once focused almost exclusively on relatively static library databases . . . digital libraries are now being viewed in some places as repositories for scholarly information assets in a broader sense."[3] However, this convergence is not universally recognized or fully supported yet. *CLIRinghouse* reports, "Higher-education executives approve budgets that help the campus library develop or lease digital resources and then buy digital course-management programs in which the library's resources are ignored. . . . Course-management software could be changed to provide direct access to campus libraries' online catalogs and databases. . . ."[4]

The decision-making process in academic institutions might be improved by the integration of academic digital content and administrative computing data, but this is another area where convergence of purpose is likely to be unrecognized—and possibly to remain so— given the complexities associated with managing each type of content independently. OSU undertook a Data Warehouse Planning and Assessment Project in September 2001 to address administrative data needed for decision support. The project began with an intensive twelve-week assessment facilitated by a consulting firm. In considering how to implement an institutional repository for academic digital content, the Knowledge Bank Planning Committee observed a number of parallels with the data warehouse initiative but acknowledged the practical need for the two projects to remain on separate tracks for the time being.

Environmental Scan

While defining the scope of the OSU Knowledge Bank, the Planning Committee considered the steps other institutions are taking to manage their digital content. The digital repositories that currently exist or are in development represent several different models.[5] For example, some are institutional in scope while others are discipline- or format-based. Another way to categorize repositories is by the type of access permitted or the nature of the hosting organization; for example, some are open access while others are commercial products to which access is restricted.[6] From a management perspective, dividing up content in these ways may remain necessary or desirable for the foreseeable future. However, the ultimate goal should be to allow institutional, subject, format or other groupings to be created virtually and at will by the user, regardless of where the content resides.

Some examples of institutional repositories include the following:

- MIT has a project under development called "DSpace" (http://www.dspace.org/live/). MIT Libraries and Hewlett-Packard are jointly developing "a scalable, sustainable digital repository for articles, technical reports, datasets, images, and

other research products in digital form produced by MIT faculty and researchers."[7] The DSpace project is intended to support adoption of the system by other institutions and federation with them. Therefore, MIT is identifying partners at other universities to implement their software when they are ready to test federated access. Although not included in the original plan for DSpace, collaborations with MIT's Open CourseWare Initiative (OCW) and Open Knowledge Initiative (OKI) are being incorporated.[8]

- The eScholarship initiative (http://escholarship.cdlib.org/) sponsored by the California Digital Library includes discipline-based archives of working papers and research results, data sets, electronic books from the University of California Press, and electronic journals published by University of California faculty. The eScholarship Repository, launched in April 2002, "provides a fast and effective method for scholars to deposit their working papers in a managed and maintained central location."[9] It includes support tools for submission, processing and dissemination that were built under a co-development partnership with Berkeley Electronic Press (bepress). To support the vision of researchers being able to search across many open repositories, eScholarship has adopted the Open Archives Initiative (OAI) metadata harvesting protocol.[10]
- The Caltech Library System is developing a digital repository for the campus (http://library.caltech.edu/digital) using freely available electronic archiving software (EPrints and ETD-db). The digital content also must be compliant with the OAI protocol so that it can be shared more easily.[11]

The institutions in the above examples began populating their repositories by working with textual materials, such as working papers and technical reports. In the following example, the institution's primary focus is to address the management of rich media content.

- Having constructed a demonstration lab with the assistance of vendor partners to model the capture, indexing, retrieval, and "repurposing" of rich media content, the University of Michigan issued an RFP for a Digital Asset Management System (DAMS) in June 2002. The Web site for the DAMS initiative, (http://sitemaker.umich.edu/dams), contains many useful links related to the project and digital asset management technology, although some may be accessed only by members of the University of Michigan community.[12]

Examples of repositories organized by format or subject include the following:

- The Open Video Project (http://www.open-video.org/) is a format-based repository originally developed at the University of Maryland and currently sponsored and developed by the University of North Carolina Chapel Hill. It is hosted as a channel of the Internet2 Distributed Storage Infrastructure. The purpose of the repository is to provide content for researchers studying digital video or multimedia problems and to allow systems to be compared through the use of a common test collection of digitized video.[13]
- MERLOT (www.merlot.org/Home.po) is a format-based repository of freely available online learning materials contributed by members of the international

educational community, including faculty, staff, and students. Within the repository, the learning objects are organized by discipline, giving it a subject orientation as well.[14]

- Online courses can be purchased from FATHOM's repository of learning materials (http://www.fathom.com/), which also includes some free resources. FATHOM was developed by an international consortium of universities, libraries, museums, and other organizations dedicated to offering high quality online learning options through a for-profit model.[15]
- The ARNO (Academic Research in the Netherlands Online) project (http://www.uba.uva.nl/en/projects/arno/) provides an example of a distributed subject repository. Its goal is to implement university document servers to make the scientific academic output of faculty at the University of Amsterdam, Tilburg University, and the University of Twente electronically accessible and interoperable. The project proposal cites the following objectives:
    - the electronic availability of academic output of an institution;
    - subject oriented interoperability of distributed digital archives, as well as interoperability with the national library infrastructure;
    - connecting this infrastructure with production processes of commercial and noncommercial publishers, especially in the submission and review of manuscripts;
    - connecting university document servers with digital learning environments.

  The participants also intend to extend the project to include other institutions.[16]

The above examples reflect not only different models for organizing digital repositories but also a variety of reasons for establishing them—including management and preservation of digital assets, increased visibility and ability to share intellectual output, alternative publishing mechanisms, and revenue generation. A common theme, however, is the emphasis on standards compliance to support desired interoperability.

Implementation Strategy

After determining that the knowledge bank concept was valid and looking at what other institutions were doing, the Knowledge Bank Planning Committee addressed the challenge of devising an implementation strategy appropriate to the campus culture and budgetary environment at Ohio State. Currently, digital content is being created and used by various campus units, but these activities are not being coordinated. In addition, the University's budget for 2002/2003 is limiting due to significant cuts imposed by the State of Ohio.

The library director discussed the knowledge bank concept with several representative faculty groups and asked for their input. The faculty members supported the concept while recognizing the long-term nature of such a project and the significant level of human and financial resources required. The critical importance of data modeling and metadata to the development of a useful and valuable institutional repository was noted, as was the improbability that a single central repository could provide ap-

propriate access to all of the various types of digital content to be included. The faculty preferred implementing an effective cross-repository searching mechanism to integrate access to distributed campus repositories and stressed the need to involve campus units in the creation of the Knowledge Bank from the beginning.

Considering this input and issues such as cost, technical feasibility, intellectual property and other policy concerns, the Knowledge Bank Planning Committee recommended a phased or modular approach to implementation. Specifically, the initial phase should focus on coordinating, supporting, and extending existing campus initiatives that might serve as building blocks for the Knowledge Bank. For example, OSU's Web Media Collective (WMC), which was funded by internal grants in 1998 and 2000, now consists of six projects in two colleges (humanities and arts) and would like to expand. Providing additional support for the WMC and other existing projects would allow the University to leverage previous investments and to accelerate development of the Knowledge Bank.

Having found the most critical implementation strategy to be increasing coordination and collaboration among campus digital endeavors, the Knowledge Bank Planning Committee recommended that the University Libraries and the Offices of the CIO jointly lead a campus-wide effort to develop the Knowledge Bank. The Committee's proposal also called for central funding to support creation of several new positions that would be dedicated to furthering the initiative.[17] However, given the current restrictive budget situation, members of the Knowledge Bank Planning Committee will continue to fulfill this role at least through 2002.

Action Plan

With these two key implementation strategies—providing essential coordination and leadership and building on existing initiatives—in mind, the Knowledge Bank Planning Committee considered next steps and developed an action plan for 2002. The action items are intended to increase awareness and visibility of the Knowledge Bank initiative, to address intellectual property issues, and to gather information needed to develop a more detailed implementation funding request for the next budget cycle. Subgroups of the Knowledge Bank Planning Committee, working in conjunction with other library or campus groups, will accomplish the action items.

Exploring Collaboration

One action item involves continuing the environmental scan and investigating more thoroughly digital repository projects at other institutions and their associated costs. A second item requires an inventory of digital initiatives currently underway on OSU's campus. The outcome of both investigations is to be documented on the Web and should help to address one of the barriers to coordination of digital initiatives at OSU—the lack of a comprehensive listing of who is doing what in this arena. In addition, both of the above action items will produce information that should be useful to the Knowledge Bank work groups responsible for two more items—evaluating technical infrastructure options, requirements, and costs and exploring partnership opportunities, such as federation with DSpace. Collaborating with others, both on and off campus, and learning from their experiences should help minimize costs and help maximize the value of

project outcomes. For example, the DSpace project is investing heavily in the development of software to support MIT's repository, but their intent is that other institutions will be able to benefit from this effort by implementing the same software to save development costs as well as to gain interoperability. Similarly, knowing what projects are being done at OSU and what technologies are being employed could reveal opportunities for savings and federation on OSU's campus.

Evaluating Standards and Tools

Another important aspect of evaluating what others are doing will be assessing what standards they are following. The desired interoperability of distributed repositories can be achieved only through standards compliance. For example, the Open Archives Metadata Harvesting Protocol (MHP) is being implemented to promote interoperability and thereby to increase the availability of digital scholarly communications. Seven institutions received funding (a total of $1.5M) from the Mellon Foundation in June 2001 to test the application of the Metadata Harvesting Protocol and to make scholarly collections more accessible on the Internet.[18] The Metadata Encoding & Transmission Standard (METS), which is being developed by the Digital Library Federation, provides an XML document format for encoding metadata necessary to manage and to exchange digital library objects within and between repositories (or between repositories and their users).[19] MacKenzie Smith discussed the relationship of METS to the DSpace project during the "Steering by Standards" videoconference hosted by OCLC in April 2002. She also talked about how DSpace relates to the Open Archival Information System (OAIS), a framework and standard addressing the long-term preservation of digital information.[20]

Both open source and commercial software tools are being used by others developing digital repositories and will need to be considered by the technical infrastructure work group. For example, Greenstone is a suite of open source software for building and distributing digital library collections, which is produced by the New Zealand Digital Library Project at the University of Waikato.[21] As noted above, the California Digital Library's e-Scholarship Repository uses software from Berkeley Electronic Press (bepress). The Web site for the DAMS initiative at the University of Michigan includes a list of a number of vendors whose products support the management of rich media assets, video encoding and logging, and content management and production. Partnerships with vendors can provide access to resources an institution could not afford on its own. As an initial step in the DAMS Initiative, a University of Michigan project team worked with vendor partners to construct a demonstration lab to model processes associated with capture, indexing, retrieval, and repurposing of rich media content.[22] Partnerships can also better position an institution to compete for grant funding.

Assessing Needs

A key action item for the Knowledge Bank Planning Committee is to assess the needs that are to be met by the Knowledge Bank, and a closely related action item is to model what it should look like. The Planning Committee identified the following expected benefits of the Knowledge Bank:

- improved access to scholarly communication throughout its life cycle (e.g., informal communications about initial research questions and data, classroom presentations, preprints, technical reports, formal publications);
- integration of content to drive knowledge (e.g., to provide improved decision support);
- synergies and economies of scale realized though cooperative effort;
- archiving and preservation of digital output to secure long-term access
- leveraging of institutional knowledge capital (e.g., innovative re-use of research and learning materials);
- revenue potential for selected items;
- increased visibility for OSU;
- fulfillment of land grant outreach mission.

What will motivate members of the University community to contribute content to the Knowledge Bank so that these benefits can be realized? The ARNO project proposal identifies one motivator as offering faculty easy solutions for publishing their output electronically while retaining the advantages of the traditional publishing system such as quality control. "Relevant motives for faculty in this respect are visibility, reputation and ease of use."[23] A faculty member at the University of California, Berkeley values reaching a larger audience through use of the eScholarship Repository—"I welcome any technology that improves people's access to our research."[24] Preservation is another motivator. As James Neal notes, "Clearly scholars want to communicate their findings and they are concerned about the long-term availability of their ideas."[25] Support for collaborative research and collaborative course development should be strong motivators for Knowledge Bank participation as well. For example, there is interest at OSU in creating a digital library of learning objects that will be relevant to multiple disciplines. Learning objects on Darwin could be used to teach biology, history, religion, etc. The Knowledge Bank should be designed to allow learning objects developed by one area to be found and accessed by other areas to which they are relevant. It should also support cooperative development of learning objects.

Along with focusing on bringing content into the Knowledge Bank, the Planning Committee must consider how the content will be accessed and used. One of the challenges in designing the Knowledge Bank is to envision how scholarly research and teaching will be done in the future. The strategic planning initiative (called PlanIT) being conducted during 2002 by OSU's Offices of the CIO is soliciting feedback from many campus groups and could offer some insights into requirements three to five years from now. Whatever the Knowledge Bank looks like at the outset, it will undoubtedly need to change over time, and it should be designed with flexibility in mind.

Currently, portals are being given much attention. In late 2000, the Association of Research Libraries (ARL) established a Scholars Portal Working Group "to advance the concept of a collective research library presence on the Web." As an initial step toward the ambitious goal of developing an entire suite of scholarly productivity tools and services to create a new academic platform for education and research, the Working Group focused on the development of a "super discovery tool" to "search, aggregate, integrate, and deliver licensed and openly available digital content across a broad range

of subject fields and from multiple institutions." To that end, the Scholars Portal Project, a collaboration between several ARL member libraries and Fretwell-Downing, Inc., was launched in May 2002. The number of participating libraries is expected to increase over the three-year project term, and planned enhancements include integration with course management systems and a digital reference service.[26] Within this context, the Knowledge Bank could be considered a portal for OSU, and the Planning Committee will need to evaluate the Scholars Portal as a potential model. At the same time, the role of the Libraries' Web site (which is being redesigned) must be considered. It makes sense to think of the Libraries' site as the primary point of entry for the Knowledge Bank, particularly when taking the broader view of its components as described above.

Addressing Policy Issues

In a thought-provoking article in *The Chronicle of Higher Education,* Malcolm Litchfield, director of the Ohio State University Press, speaks in favor of the library-as-portal concept and a shift away from disseminating scholarly communication through the commercial marketplace to a more direct solution, such as institutional repositories. He suggests that this could result in a more efficient use of university funds as well as enhanced scholarship, but he acknowledges that significant cultural hurdles will have to be overcome for this shift to occur.[27] Promotion and tenure processes and intellectual property issues are major concerns that must be addressed. How does the peer review system relate to the institutional repository concept? What intellectual property policies must be in place for faculty to embrace an institutional repository as the storehouse for their scholarship? Clearly these are very large issues that will take time to resolve. A lecture series sponsored by the OSU Libraries in 2002 and 2003 seeks to engage faculty in discussions about the future of scholarly communication. A Knowledge Bank Planning Committee work group intends to collaborate with other appropriate groups on campus to address the issue of ownership of information as it relates to the creation of the OSU Knowledge Bank.

Doing a Pilot Project

To help identify and work through other organizational issues, the Knowledge Bank Planning Committee identified a pilot project to create a faculty research directory as an additional action item. Faculty at Ohio State must prepare annual reports of their teaching, research, and service activities as part of their promotion and tenure documentation. If the time and effort involved in complying with this requirement could be reduced, the faculty could be expected to respond favorably. If a useful new product for the campus could be generated at the same time, that would be an added benefit. The annual reports include lists of publications but they tend to be internal departmental documents. There is no comprehensive, cumulative listing of all OSU faculty publications and creative works. In a recent article on knowledge management, Martin Dillon notes the general need for this type of development and asserts that it is an appropriate task for the library to take up—"Nowhere that I can find is it possible, using a simple search, to obtain a list of faculty publications on a specific topic."[28] Once established, the faculty research directory could be extended to include e-portfolios for faculty with

links to the full-text of their publications. Because faculty are producing the content anyway as part of the promotion and tenure process, a directory of faculty research and creative activity could be a low cost, high-impact project for the University.

Evaluating what others are doing, assessing our own needs (functional and technical), addressing policy issues, and experimenting with some pilot projects should enable the Knowledge Bank Planning Committee to propose a more detailed implementation plan and funding request. But what will convince those in a position to provide support to make the Knowledge Bank a priority? It will be necessary to demonstrate economic viability in addition to articulating the expected benefits in a manner that engenders campus buy-in. At this point, the costs associated with building an institutional repository are unclear and the revenue generation potential is not known. A position paper on institutional repositories issued in 2002 by the Scholarly Publishing and Academic Resources Coalition (SPARC) reports that the diversity of scope and technical execution of such projects to date has made it difficult to predict either development or operating costs for new repositories. It also notes that the cost of preservation archiving for digital collections is generally unknown. There is agreement among those who have implemented institutional repositories so far that the effort associated with addressing policy, content management, and marketing issues far exceeds the technical effort required by such projects.[29] The MIT Libraries received funding from the Mellon Foundation to examine the economics of building and maintaining a digital repository such as DSpace, including the development of a business plan.[30] The outcome of this effort will be of considerable interest.

Conclusion

The knowledge bank concept articulated by the OSU Distance Learning/Continuing Education Committee is one that other institutions also are addressing. The Knowledge Bank Planning Committee found that a number of initiatives underway within and outside OSU are related to this concept. The growing interest is evidenced by a recent article on "superarchives" in *The Chronicle of Higher Education*, the SPARC position paper noted above, and an October 2002 workshop on institutional repositories planned by SPARC, the Association for Research Libraries, and the Coalition for Networked Information.[31] The converging initiatives and interest seem to make this an opportune time for OSU to invest in Knowledge Bank development. The action items described above will help to define more clearly what level of investment is required and what the expected outcomes are.

Whether a broad view is taken in defining the Knowledge Bank or the primary focus becomes the institutional repository component, the real issue is what needs will be met in the end. It is not simply a question of what system to buy or build, but how to integrate the concept, as well as the technology, with what already exists, and develop it further. Convergence is at once a trend, a strategy, and a desired outcome. There is interest in bringing the various forms of academic digital content together. Academic libraries should be key players in this movement because they are in the best position to articulate how such new initiatives relate to traditional information services. They should take a leadership role in building convergence of purpose and direction that will allow

members of the campus community to achieve outcomes of greater significance through collaboration than might be achieved independently.

Does the current interest in institutional repositories represent a hot topic of the moment that will be insignificant in a year or two, or is this the early stage of a true revolution in digital content management? Dillon comments, " . . . knowledge management, always crucial to success in the paper world, is even more central as the knowledge world goes digital."[32] And Litchfield observes, "The presumed electronic revolution may affect scholarly communication in ways much more dramatic and fundamental than simply changing the medium of communication. Especially in the academic community, we should dare to think large, bold thoughts that revolutionize the current world."[33] Implementing the Knowledge Bank will not be just a matter of building an archive of digital intellectual content but of changing how the campus community thinks about producing, saving, and sharing that content and how it is valued. This will not be an easy process and it will take time. We seem to be standing on the doorstep of revolutionary change; whether we can push the door wide open and step through is a question yet to be answered.

Sally A. Rogers is Assistant Director for Information Technology at Ohio State University Libraries; she may be contacted via e-mail at: rogers.19@osu.edu.

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